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ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample and a personnel evaluation form are also included. (AG)

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S-450 S-450

June 1970

U.S. Training and
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Technical Report
S-450

Development of USTES

APTITUDE TEST
BATTERY FOR

PROGRAMMER, DETAIL, GRAPHIC ARTS

(clerical)
219.388

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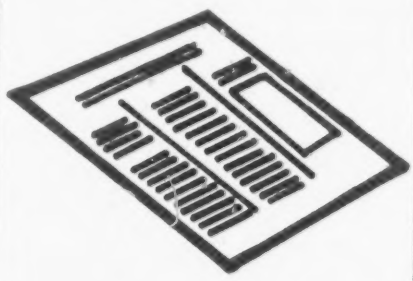

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Technical Report on Development of USTES Aptitude Test Battery

For . . . . .

Programmer, Detail, Graphic Arts (clerical) 219.388

S-450

(Developed in cooperation with the
Colorado State Employment Service)

Manpower Administration
U.S. Department of Labor

June 1970

FOREWORD

The United States Training and Employment Service General Aptitude Test Battery (GATB) was first published in 1947. Since that time the GATB has been included in a continuing program of research to validate the tests against success in many different occupations. Because of its extensive research base the GATB has come to be recognized as the best validated multiple aptitude test battery in existence for use in vocational guidance.

The GATB consists of 12 tests which measure 9 aptitudes: General Learning Ability, Verbal Aptitude, Numerical Aptitude, Spatial Aptitude, Form Perception, Clerical Perception, Motor Coordination, Finger Dexterity, and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, with a standard deviation of 20.

Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, in combination, predict job performance. For any given occupation, cutting scores are set only for those aptitudes which contribute to the prediction of performance of the job duties of the experimental sample. It is important to recognize that another job might have the same job title but the job content might not be similar. The GATB norms described in this report are appropriate for use only for jobs with content similar to that shown in the job description included in this report.

GATB-2783

DEVELOPMENT OF USTES APTITUDE TEST BATTERY

For

Programmer, Detail, Graphic Arts (clerical) 219.388-206

This report describes the research undertaken for the purpose of developing General Aptitude Test Battery (GATB) norms for the occupation of Programmer, Detail Graphic Arts (clerical) 219.388-206. The following norms were established:

GATB Aptitudes	Minimum Acceptable GATB Scores
N - Numerical Aptitude	95
S - Spatial Aptitude	85
K - Motor Coordination	85

Research Summary

Sample:

60 trainees (58 males and 2 females) from various printing firms in the United States and Canada who were enrolled in a six-week Computer Programming and Operation course at the ITU Training Center in Colorado Springs, Colorado. This study was conducted prior to the Colorado agency receiving permission to collect minority group information. Therefore, minority group composition is unknown.

Criterion:

Instructor's descriptive rating scale for trainees.

Design:

Longitudinal tests were administered during the initial phases and criterion data were not obtained until completion of training.

Minimum aptitude requirements were determined on the basis of job analysis, and statistical analyses of aptitude mean scores, standard deviations, aptitude-criterion correlations, and selective efficiencies.

Predictive Validity:

Phi Coefficient = .49 ($P/2 < .0005$)

Effectiveness of Norms:

Only 67% of the non-test-selected trainees used for this study were good trainees; if the trainees had been test-selected with the above norms, 80% would have been good trainees. 33% of the non-test-selected trainees used for this study were poor trainees; if the trainees had been test-selected with the above norms, only 20% would have been poor trainees. The effectiveness of the norms is shown graphically in Table 1:

TABLE 1

Effectiveness of Norms

	Without Tests	With Tests
Good Trainees	67%	80%
Poor Trainees	33%	20%

Sample Description

Size:

N = 60

Occupational Status:

ITU members employed as craftsmen in the printing and publishing industry who were in training to become detail programmers.

Work Setting:

Subjects were enrolled in a six-week computer programming and operation program at the ITU Training Center in Colorado Springs, Colorado.

Selection Requirements:

Age: No requirement
Education: No requirement
Tests: None
Previous Experience: No requirement
Other: ITU members who would attend the training on their own time and pay their own expenses or who were sent by their employer at his expense.

Principal Activities:

The job duties for each worker are comparable to those shown in the Fact Sheet in the Appendix.

Minimum Experience:

All trainees were tested during the initial phase of training. None had any previous experience in detail programming.

TABLE 2

Means, Standard Deviations (SD), Ranges, and Pearson Product-Moment Correlations with the Criterion (r) for Age and Education

	Mean	SD	Range	r
Age (years)	37.4	9.1	23-65	-.404**
Education (years)	12.3	1.4	8-16	.295*

**Significant at the .01 level
* Significant at the .05 level

Experimental Test Battery

All twelve tests of the GATB, B-1002A or B were administered to the validation sample during the period July 1967 through January 1969.

Criterion

The criterion data consisted of Instructor's Descriptive Rating Scale for Trainees obtained after the subject had completed the training. Trainee performance ratings were collected between December 1967 and January 1970. One composite rating was obtained for each trainee covering the various duties of the program.

Rating Scale:

An adaptation of USTES Form SP-21T, Descriptive Rating Scale for Trainees (see appendix). The scale consists of eight items covering different aspects of training performance with five alternatives for each item.

Reliability:

Only one rating was obtained for the subjects, therefore, a reliability coefficient was not obtained.

Criterion Score Distribution:

Possible range	:	8 - 40
Actual range	:	8 - 40
Mean	:	24.9
Standard Deviation:		7.5

Criterion Dichotomy:

The criterion distribution was dichotomized into high and low groups by placing 33% of the sample in the low criterion group to correspond with the percentage of trainees considered marginal or unsatisfactory. Trainees in the high criterion group were designated as "good trainees" and those in the low criterion group as "poor trainees." The critical criterion score is 22.

Aptitudes Considered for Inclusion in the Norms

Aptitudes were selected for tryout on the basis of a qualitative analysis of job duties involved and a statistical analysis of test and criterion data. Aptitude Q was included because it was rated important to the job duties and because the sample had a relatively high mean score on this aptitude. Tables 3, 4 and 5 show the results of the qualitative and statistical analyses.

TABLE 3

Qualitative Analysis

(Based on the job description and observation of the job, the aptitudes indicated appear to be important to the work performed.)

Aptitude	Rationale
G - General Learning Ability	Necessary to become familiar with and understand the capabilities and limitations of a computer and adapt those principles by which the machine operates, thus facilitating the most efficient and effective method of processing data.
V - Verbal Ability	Necessary to read, understand, and confer with supervisors and representatives of departments regarding data pertinent to programming, as well as programming for effective production of words, sentences, and paragraphs.

N - Numerical Aptitude	Necessary to understand and reason mathematical operations quickly and accurately, to reason quantitatively. To be able to arrange computations into proper program sequence for computer operations.
S - Spatial Aptitude	Necessary to develop and interpret flow charts and diagrams; and to visualize flow of data through the computer system.
P - Form Perception	Necessary to perceive pertinent detail in the programming process as well as the final product, make visual comparisons and discriminations and see differences in shapes and shadings of figures and widths and lengths of lines.
Q - Clerical Perception	Necessary to perceive pertinent detail in program documentation, assembled data and recommended program routine, and recognize and detect errors in instructions, etc.
K - Motor Coordination	Necessary to coordinate eyes and hands or fingers accurately to prepare and complete flow charts.

TABLE 4

Means, Standard Deviations (SD), Ranges, and Pearson Product-Moment Correlations with the Criterion (r) for the Aptitudes of the GATB.

N = 60

Aptitude	Mean	SD	Range	r
G - General Learning Ability	116.9	17.0	76-161	.515**
V - Verbal Aptitude	113.3	14.8	78-147	.284*
N - Numerical Aptitude	114.2	18.2	72-155	.424**
S - Spatial Aptitude	112.9	18.9	65-160	.401**
P - Form Perception	112.4	19.3	68-166	.253
Q - Clerical Perception	126.7	19.7	78-194	.197
K - Motor Coordination	105.5	16.3	66-153	.271*
F - Finger Dexterity	100.5	19.8	55-149	.195
M- Manual Dexterity	111.3	17.6	69-157	.275*

* Significat at the .05 level.
**Significant at the .01 level.

TABLE 5

Summary of Qualitative and Quantitative Data

Type of Evidence	Aptitudes								
	G	V	N	S	P	Q	K	F	M
Job Analysis Data:									
Important	X	X	X	X	X	X	X		
Irrelevant									
Relatively High Means	X		X			X			
Relatively Low Standard Deviations		X							
Significant Correlation with Criterion	X	X	X	X			X		X
Aptitudes to be considered for Trial Norms	G	V	N	S		Q	K		M

Deviation and Validity of Norms

Final norms were derived on the basis of a comparison of the degree to which trial norms consisting of various combinations of Aptitudes N, S, and K at trial cutting scores were able to differentiate between the 67% of the sample considered good trainees and the 33% considered poor trainees. Trial cutting scores at the five point interval nearest to one standard deviation below the mean for each aptitude are tried because this will eliminate about one-third of the sample with three-aptitude norms. For two-aptitude norms, minimum cutting scores slightly higher than one standard deviation below the mean will eliminate about one-third of the sample; for four-aptitude trial norms, cutting scores of slightly lower than one standard deviation below the mean will eliminate about one-third of the sample. The Phi Coefficient was used as a basis for comparing trial norms. Norms of N-95, S-85 and K-85 provided optimum differentiation for the occupation of Programmer, Detail (graphic arts), (clerical) 219.388-206. The validity of the norms is shown in Table 6 and is indicated by a Phi Coefficient of .49 (statistically significant at the .0005 level).

TABLE 6

Predictive Validity of Test Norms, N-95, S-85, and K-85

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Trainees	3	37	40
Poor Trainees	11	9	20
Total	14	46	60

Phi Coefficient (ϕ) = .49
Significance Level = P/2 $<$ .0005

Chi Square (X^2y) = 14.3

Determination of Occupational Aptitude Pattern

The data for this study met the requirements for incorporating the occupation studied into OAP-38 which is shown in the 1970 edition of Section II of the Manual for the General Aptitude Test Battery. A Phi Coefficient of .41 is obtained with the OAP-38 norms of N-80, S-85, and K-80.

APPENDIX

RATING TRAINEES

DESCRIPTIVE RATING SCALE

(For Aptitude Test Development Studies)

Score _____

RATING SCALE FOR _____
(DOT Title and Code for Training Course)

Directions: Please read "RATING TRAINEES - SUGGESTIONS TO RATERS" and then complete this rating scale. In making your ratings, only one box should be checked for each question.

Name of trainee (print) _____
(Last) (First)

Sex: Male_____ Female _____

INFORMATION TO BE PROVIDED BY RATER

RATED BY _____

TITLE _____

LOCATION OF TRAINING _____ DATE _____
(City) (State)

A. How much aptitude or facility does he have for the vocational training? (Trainee's adeptness or knack for performing the work easily and well.)

☐ 1. Has great difficulty doing the work. Not at all suited for the training.
☐ 2. Usually has some difficulty doing the work. Not too well suited for the training.
☐ 3. Does the work without too much difficulty. Fairly well suited for the training.
☐ 4. Usually does the work without difficulty. Well suited for the training.
☐ 5. Does the work with great ease. Exceptionally well suited for the training.

B. How much ability does he have for maintaining adequate production in the vocational activity for which he was trained?

☐ 1. Capable of very low work output. Can perform only at an unsatisfactory pace.
☐ 2. Capable of low work output. Can perform at a slow pace.
☐ 3. Capable of fair work output. Can perform at an acceptable but not a fast pace.
☐ 4. Capable of high work output. Can perform at a fast pace.
☐ 5. Capable of very high work output. Can perform at an unusually fast pace.

C. How good was the quality of his work during the vocational training?

☐ 1. Performance was inferior and almost never met minimum quality standards.
☐ 2. Performance was usually acceptable but somewhat inferior in quality. The grade of his work could stand improvement.
☐ 3. Performance was acceptable but usually not superior in quality.
☐ 4. Performance was usually superior in quality.
☐ 5. Performance was almost always of the highest quality.

D. How quickly did he learn the instructional units of the vocational training?

☐ 1. Learned the work very slowly. Needed careful and repeated instructions.
☐ 2. Learned the work somewhat slower than most.
☐ 3. Learned most of the work in the usual amount of time.
☐ 4. Learned most of the work quickly.
☐ 5. Learned all of the work very rapidly. Needed only the minimum amount of training or instructions for even the difficult aspects.

E. How much ability does he have for using the equipment of the vocational training?

☐ 1. Has very limited ability. Cannot use the equipment adequately.
☐ 2. Has little ability. Can use the equipment to "get by."
☐ 3. Has a moderate amount of ability. Can use the equipment to do fair work.
☐ 4. Has high ability. Can use the equipment to do good work.
☐ 5. Has very high ability. Can use the equipment to do excellent work.

F. How large a variety of job duties can he perform efficiently?

☐ 1. Cannot perform different operations adequately.
☐ 2. Can perform a limited number of different operations efficiently.
☐ 3. Can perform several different operations with reasonable efficiency.
☐ 4. Can perform many different operations efficiently.
☐ 5. Can perform an unusually large variety of different operations efficiently.

G. How resourceful is he in coping with work situations that are different or out of the ordinary?

☐ 1. Almost never is able to figure out what to do. Needs help on even minor problems.
☐ 2. Often has difficulty handling new situations. Needs help on all but simple problems.
☐ 3. Sometimes knows what to do, sometimes doesn't. Can deal with problems that are not too complex.
☐ 4. Usually able to handle new situations. Needs help on only complex problems.
☐ 5. Practically always figures out what to do himself. Rarely needs help, even on complex problems.

H. Considering all the factors already rated, and only these factors, how acceptable was his performance during vocational training?

☐ 1. Performance was unsatisfactory.
☐ 2. Performance was not completely satisfactory.
☐ 3. Performance was satisfactory.
☐ 4. Performance was good.
☐ 5. Performance was outstanding.

June 1970

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FACT SHEET

Job Title: Programmer, Detail, (Graphic Arts), (clerical) 219.388-206

Job Summary: Prepares program low charts or decision tables as required. Writes the programs within the graphic arts industry and develops operation requirements. May also be required to be capable of business application programming.

Work Performed: Adapts presently available EDP manufacturers' programs, as needed to permit a conversion from hot-metal typesetting to cold type, using knowledge of programming techniques to modify manufacturers' available typesetting programs to the specific needs of the using establishment. Must be knowledgeable of various phases of the program in order to enter changes in column width, indentation, punctuation, and overall format.

Must be capable of conferring with supervisors and representatives of department (s) such as the graphic arts, circulation, advertising, etc. to verify program concepts, output requirements, input media, and internal checks and audits. Capability to analyze work flow charts, decision tables or diagram representing specific function by applying knowledge of computer capabilities and subject matter to develop sequence of program steps. Converts written statements of functions to detailed logical flow charts or decision tables as required for coding into computer language peculiar to make or model of the computer, to develop successive steps necessary to complete the program for machine processable instructions. Marks code sheets to indicate relationship of code to program. Must be capable of debugging and testing the program to meet system requirements prior to production status and to provide complete detail program documentation and operating instructions.

In addition to the above it will be necessary to be capable of operating the equipment.

Effectiveness of Norms : Only 67% of the non-test-selected trainees used for this study were good trainees; if the trainees had been test-selected with the S-450 norms, 80% would have been good trainees. 33% of non-test-selected trainees used for this study were poor trainees; if the trainees had been test-selected with the S-450 norms, only 20% would have been poor trainees.

Applicability of S-450 Norms : The aptitude test battery is applicable to training stituations which include most of the training described above or to entry on jobs similar to the above job description.

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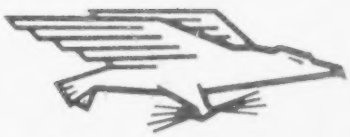

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